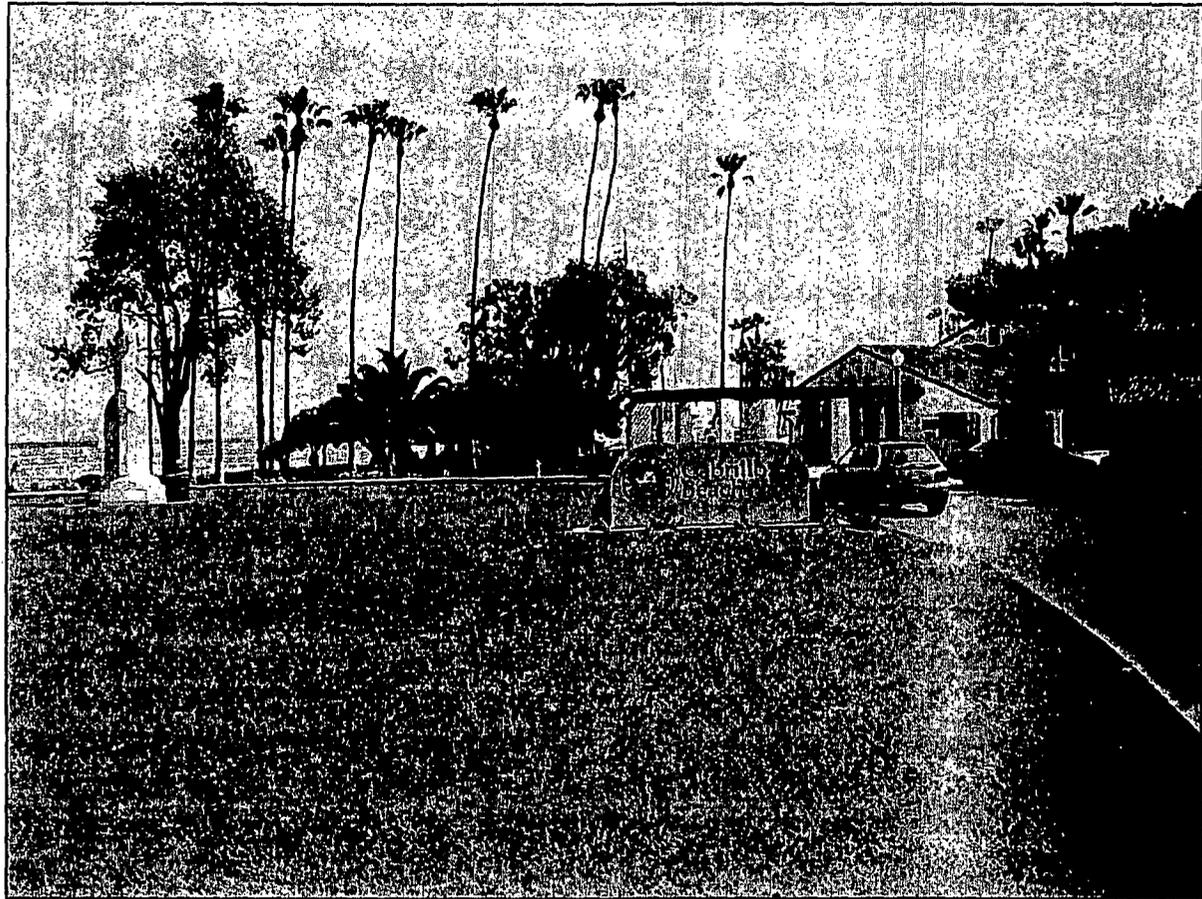


Task 1 Final Report

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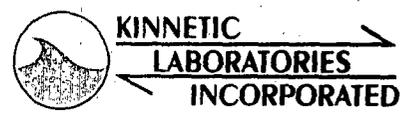
COMPILATION OF PERTINENT DATA
INNER CABRILLO BEACH WATER QUALITY IMPROVEMENT PROJECT



City of Los Angeles
Harbor Department



Prepared By
Kinnetic Laboratories Inc.
31 March 2003
(Final Revision 30 May 2003)



COMPILATION OF PERTINENT DATA
INNER CABRILLO BEACH WATER QUALITY IMPROVEMENT PROJECT

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LBWindAll.xls	
LATideAll.xls	
LACSD_SanGabrielRiver_StationR8_1991-2002.xls	
LACSD_Shore_and_inshore_bactidata_1991-2002.xls	
LAPalosVerdesFlowStudy.zip	
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Dominquez Report	
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Figures (all).pdf	
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CabrilloReadMe.doc	

A number of sources of potential contamination have been identified including sewage leaks, beach trash (including dirty diapers), direct deposition of human feces into the water, and/or feces of birds or other animals. Because high levels of bacteria are present during dry weather the bacteria cannot be exclusively attributed to stormwater contamination. Poor water circulation at the Inner Cabrillo Beach may result in a failure to dilute and disperse bacteria. The presence of an eelgrass bed just off the beach may further limit water movement adjacent to the shore. While area studies have not revealed any sewer leaks, virus studies revealed the presence of human enteroviruses on one occasion (viral studies were only conducted on two days) (Noble, 2000). The source of human contamination may be from diapers, either on young children allowed to play in the water or from diapers that have been disposed of improperly.

Based on the elimination of sewage leaks and stormwater pollution as major sources of contamination at Cabrillo Beach, the large population of roosting gulls was identified as the most significant source of bacterial contamination. In order to reduce the population and use of the beach by gulls, a bird exclusion structure was constructed in September of 2000. In addition, the implementation of a covered trash can program at the beach was recommended to limit the trash foraging activities of the birds.

The bird exclusion structure consists of poles placed in a grid fashion, approximately fifty feet apart (Figures 7-2 and 7-3). Dacron braid is strung in a crisscross pattern from the top of the poles. The structure is designed to be a visual deterrent to the birds, discouraging them from attempting to land on the beach area beneath the Dacron lines.

7.3 Preliminary Results of the Exclusion Study

The initial report from the Environmental Affairs Department on efficacy of the bird exclusion structure at Inner Cabrillo Beach suggested that the structure had a positive impact on water quality in the exclusion area (CLA, 2001).

Results of preliminary data collection efforts revealed that the structure minimized resting by birds on the swimming beach beneath the bird structure (CLA, 2001). Figure 7-4 illustrates bird usage on the northern and southern portions of Cabrillo Beach as well as daily bacterial data for total coliform, fecal coliform, and *enterococcus* for the month of August 2000, just prior to installation of the exclusion structure. This figure illustrates lesser usage of the southern portion of the beach by birds and highly variable bacterial levels, though it is difficult to make a direct correlation between the two. Figure 7-5 presents similar data for the month of September 2000. Bacteria concentrations, particularly fecal coliform, flatten out dramatically following installation of the bird exclusion structure on 19 September. One exception is the data for 30 September, which indicates a spike in concentrations not obviously attributable to bird usage. Although it is difficult to compare bird count data to that of the previous month, gull usage of the beach area beneath the structure appears to have decreased significantly. Figure 7-6 presents similar data for the month of October 2000. High bacterial concentrations appear to correlate somewhat with precipitation. It is difficult to ascertain the effect of bird usage on bacterial concentrations from these data. Gull usage of the area beneath the exclusion structure obviously diminished from that of August 2000. Figures 7-4, 7-5, and 7-6 are from CLA 2001, Attachment C.

From 19 October 2000 through 5 January 2001, 96% of total birds present on the beach were observed on the northern portion of the beach and only 4% of the birds were on the southern portion beneath the bird exclusion structure (CLA, 2001). The majority of birds on the beach were gulls, whereas pigeons were the primary beach users beneath the exclusion structure.

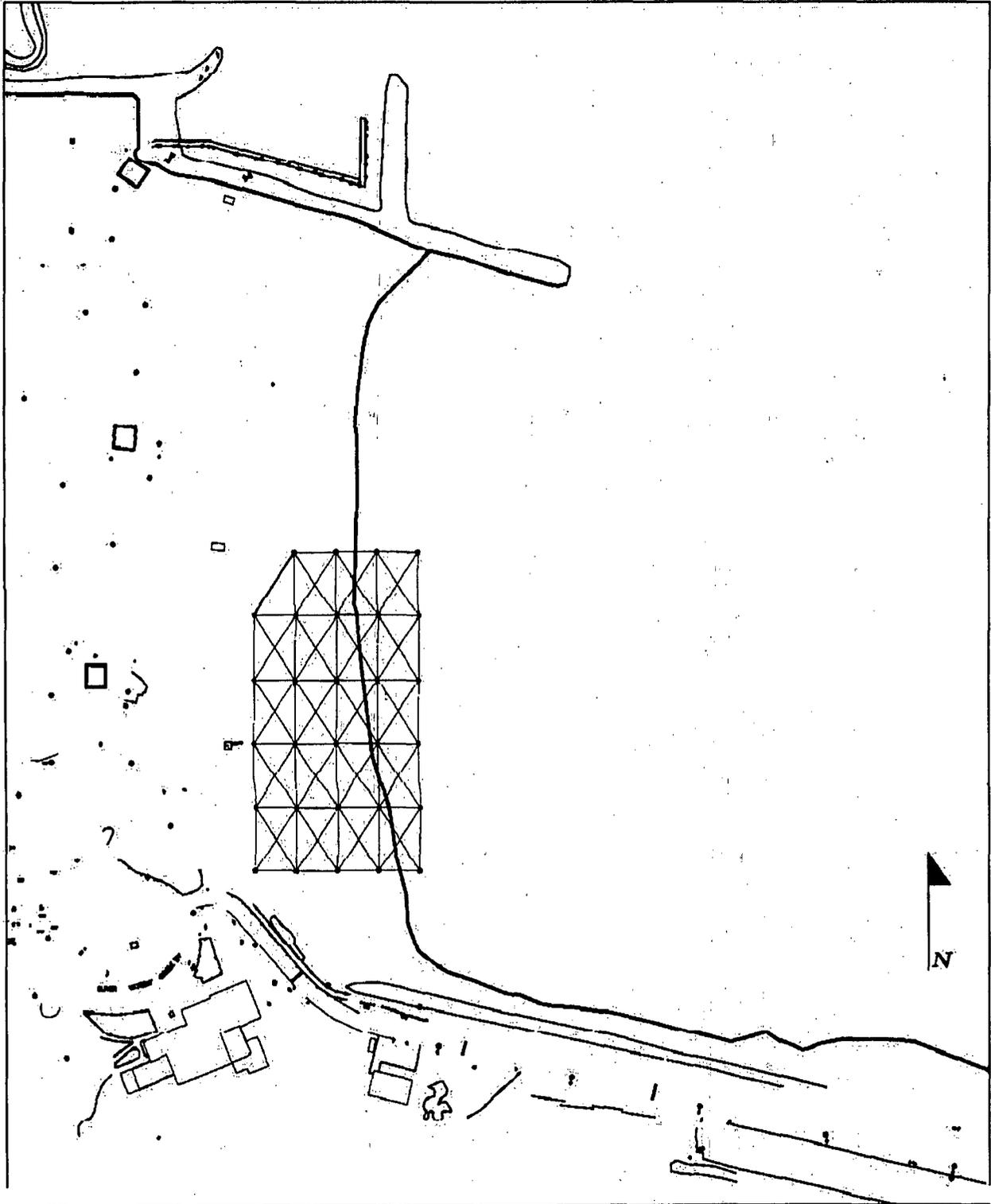


Figure 7-2. Approximate Location of Bird Exclusion Structure at Cabrillo Beach

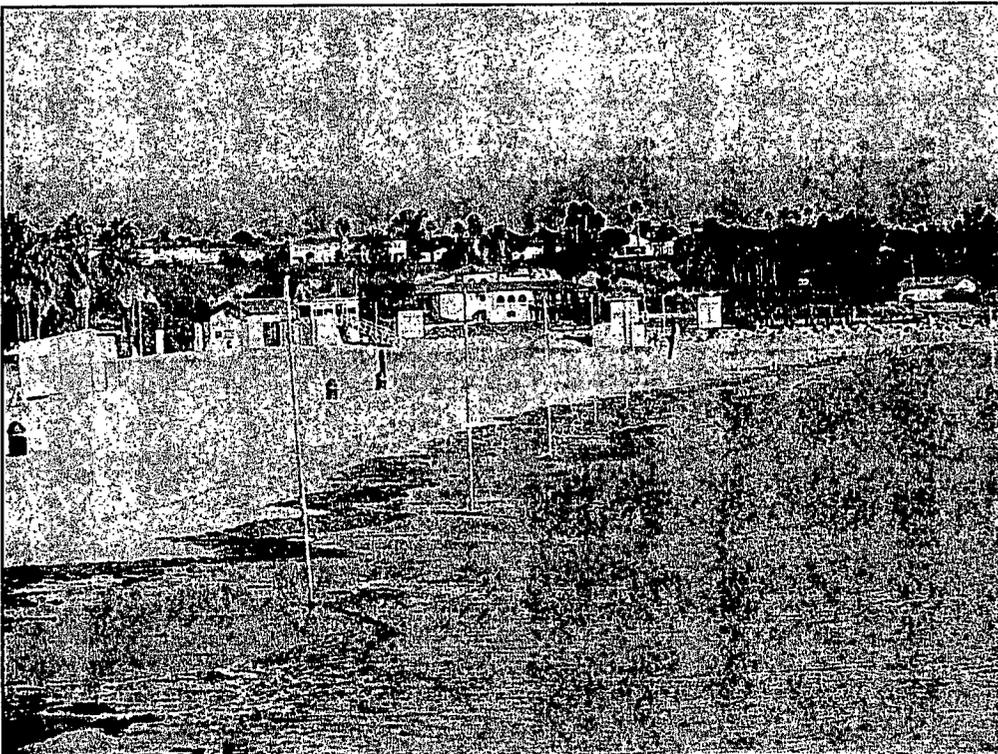
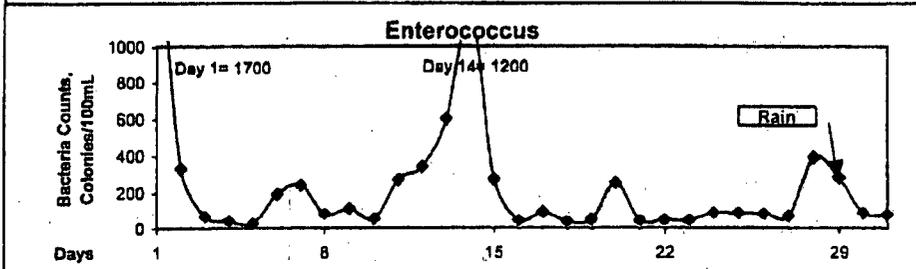
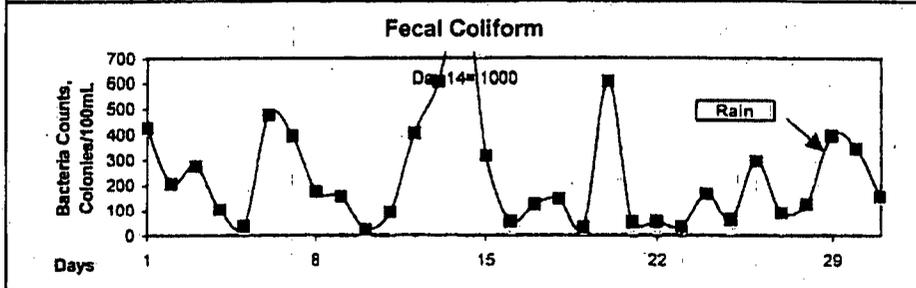
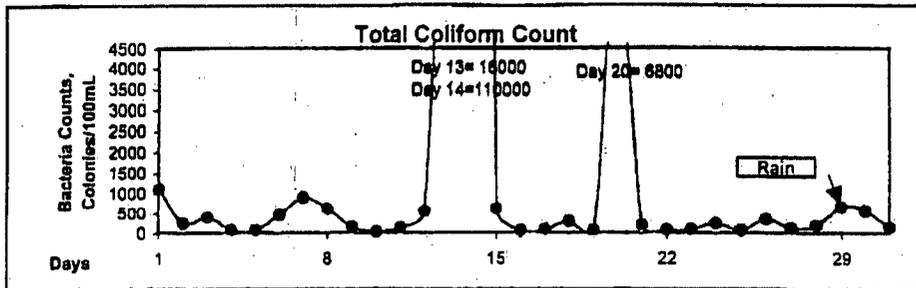


Figure 7-3. Bird Exclusion Structure at Cabrillo Beach

BACTERIOLOGICAL DATA



BIRD COUNT DATA

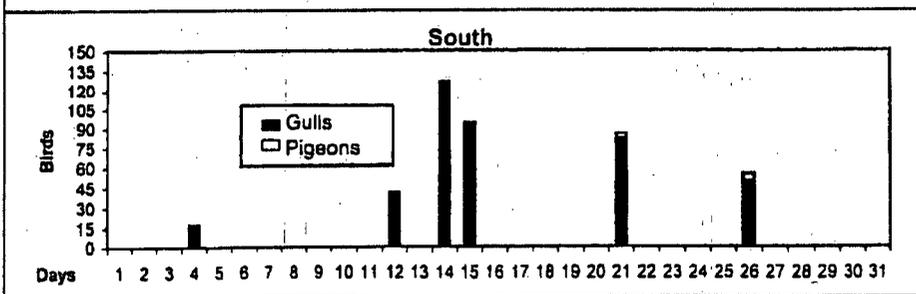
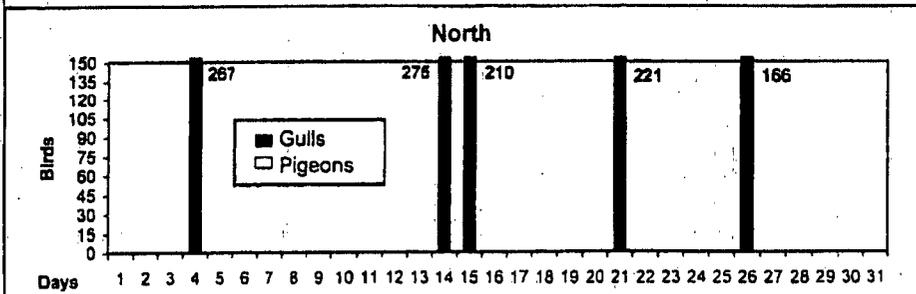


Figure 7-4. Cabrillo Beach Bird Counts and Bacterial Data, August 2000 (CLA 2001)

BACTERIOLOGICAL DATA

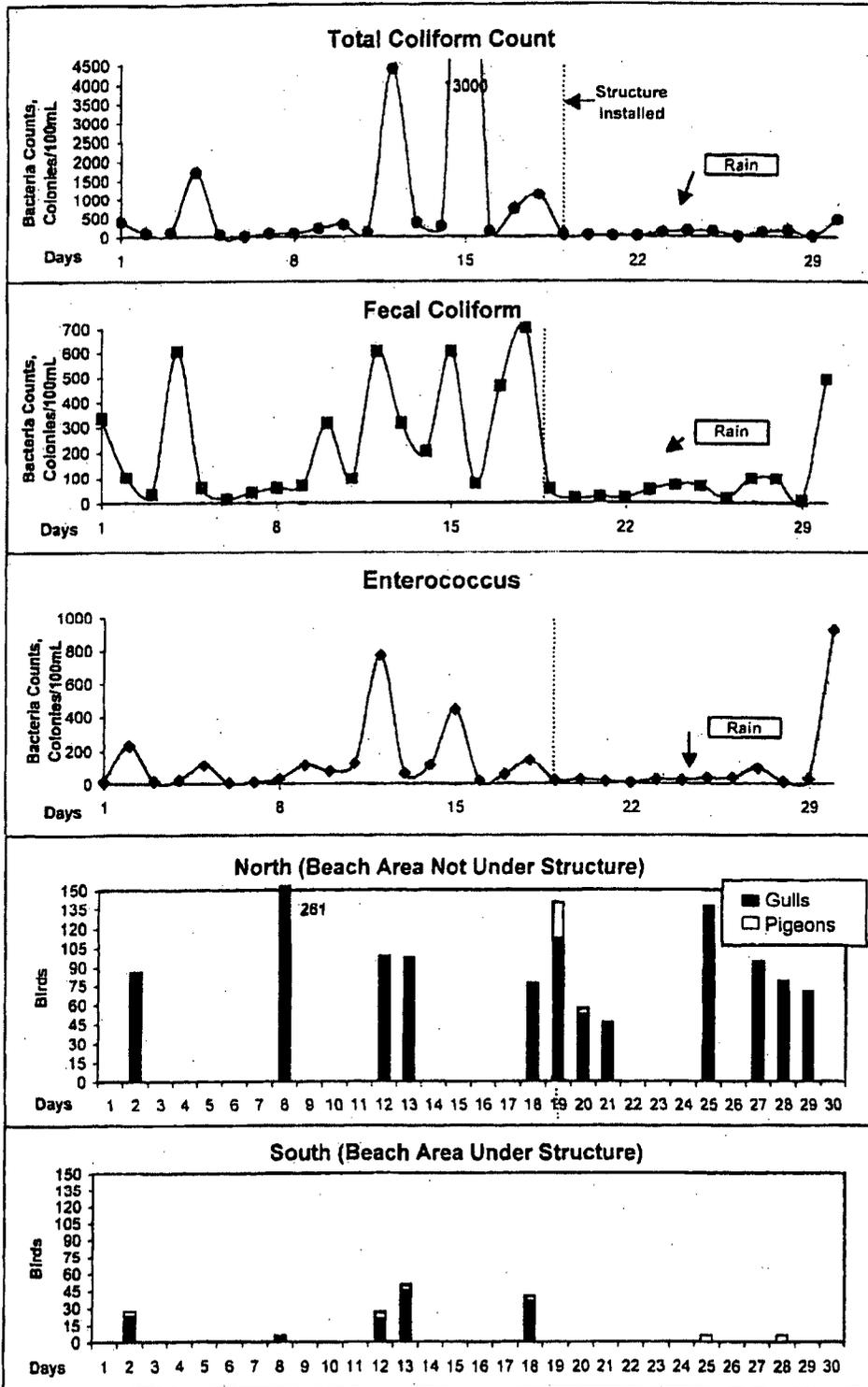
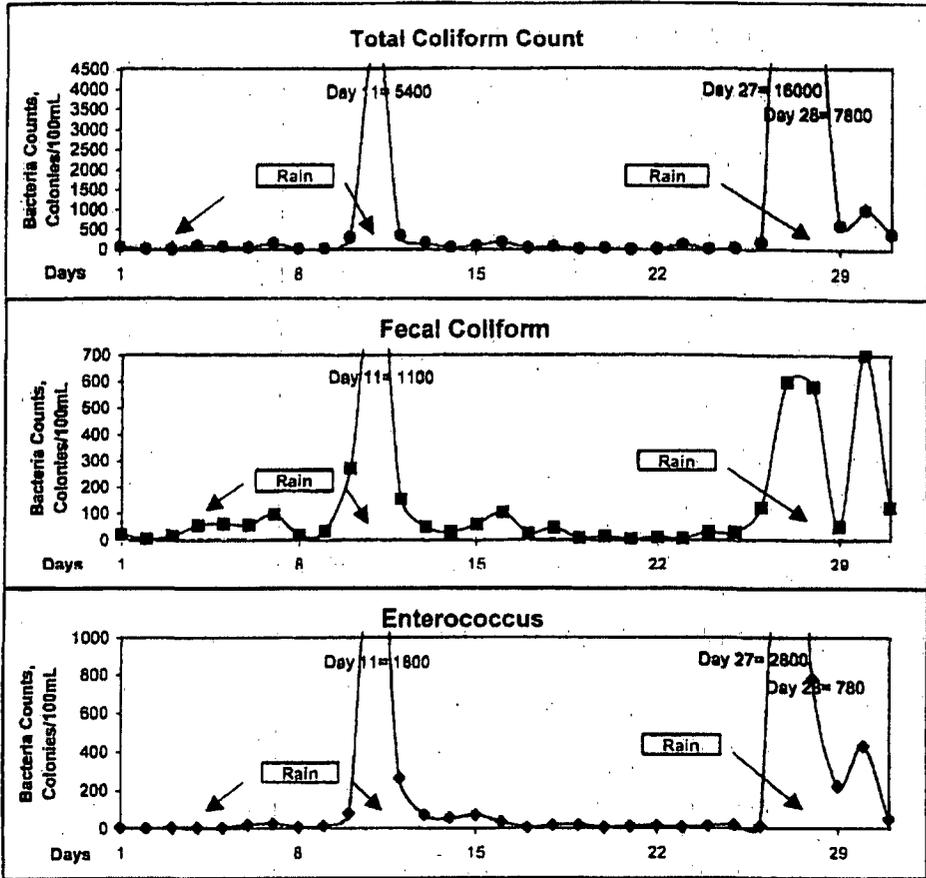


Figure 7-5. Cabrillo Beach Bird Counts and Bacterial Data, September 2000 (CLA 2001)

BACTERIOLOGICAL DATA



BIRD COUNT DATA

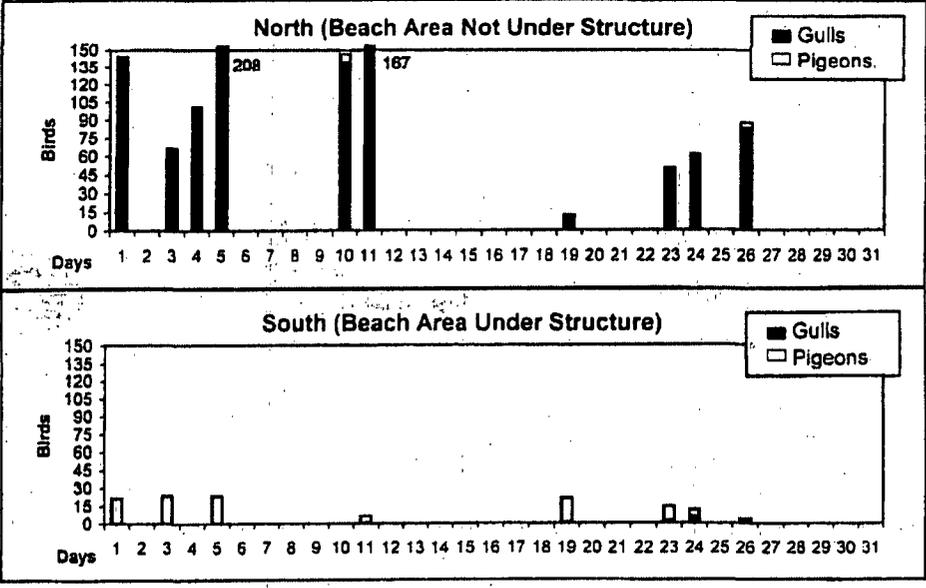


Figure 7-6. Cabrillo Beach Bird Counts and Bacterial Data, October 2000 (CLA 2001)

Shoreline water samples collected on the south side of the beach in the area beneath the anti-bird structure had lower total and fecal coliform and enterococcus bacteria concentrations immediately following installation of the structure (CLA, 2001). Short periods of high concentrations may possibly be attributed to rainfall events or increased attendance during holidays (CLA, 2001).

Although the bird count data appear to show that the exclusion structure has been effective in decreasing the bird usage of the southern portion of Cabrillo Beach (Figure 7-7), several inconsistencies exist within the data set. Bird count monitoring was irregular; whereas numerous and sometimes almost daily bird counts occurred in some months, several months during the study period included counts for only one day. Bird count days per month ranged from one to twenty-six days per month; more frequent bird counts occurred prior to the installation of the structure.

Some of the count numbers do not accurately reflect the avian presence on the beach. Species other than gulls were occasionally present on the beach in substantial numbers, although the CLA report (15 February 2001) considers only gull and pigeon numbers, rather than total bird numbers. The data also includes temporally equivalent data sets that do not contain the same numbers; the nutrient data file includes only gull numbers. Some data points include birds in the water or on floats some distance from the beach. It is impossible to determine the numbers of birds on the beach as opposed to those in the water or perched on floats.

CLA (2001) makes several recommendations to improve water quality at Cabrillo Beach. The report recommended continued daily monitoring of bacteria and bird counts. Additionally, the IDEXX Quanti-Tray method for bacteria testing was recommended to provide a more accurate and robust measure of bacteria counts at the different sites on Cabrillo Beach. The report also advocated an investigation of the feasibility and benefit of enhanced educational outreach including flyers, signs and other information sources. Finally, the report recommended preparing an additional report to assess the one-year effectiveness of the bird exclusion structure and to provide recommendations for additional measures for continued water quality improvements at Cabrillo Beach.

7.4 Recent Bird Exclusion Study Results

A subsequent study completed in January of 2003 confirmed the initial findings of the 15 February 2001 report (Dalkey and Baharance, 2003). This study found significantly decreased bird usage of the beach beneath the bird exclusion structure compared to the non-excluded part of the beach. Although total numbers of birds on the beach varied widely between surveys, the area beneath the bird exclusion structure had, on average, 95% fewer birds than the uncovered area. Bacteria levels were, on average, 20% higher at the site outside of the bird exclusion structure, (CBE) than at the sample site under the structure (CB2). The frequency of exceedances of the California State Bathing Water standards decreased by 65% following the installation of the bird exclusion structure (Dalkey and Baharance, 2003).

Pigeons and "Other Birds" were counted daily from July 2001 to June 2002 at the time of bacterial sample collection. Figure 7-8 illustrates bird usage of Cabrillo Beach, by area (i.e. northern or southern) and by species (pigeon or other). Bacterial samples were collected in the area beneath the bird exclusion structure and in area outside of the bird exclusion structure. Figure 7-9 presents three graphs illustrating bacterial water quality at the two sites. After installation of the structure, total coliform rarely exceeded water quality standards at CBE, and never exceeded standards under the exclusion structure at CB2. Fecal coliform infrequently exceeded water quality standards at CBE, and only rarely did so at CB2. *Enterococcus* more

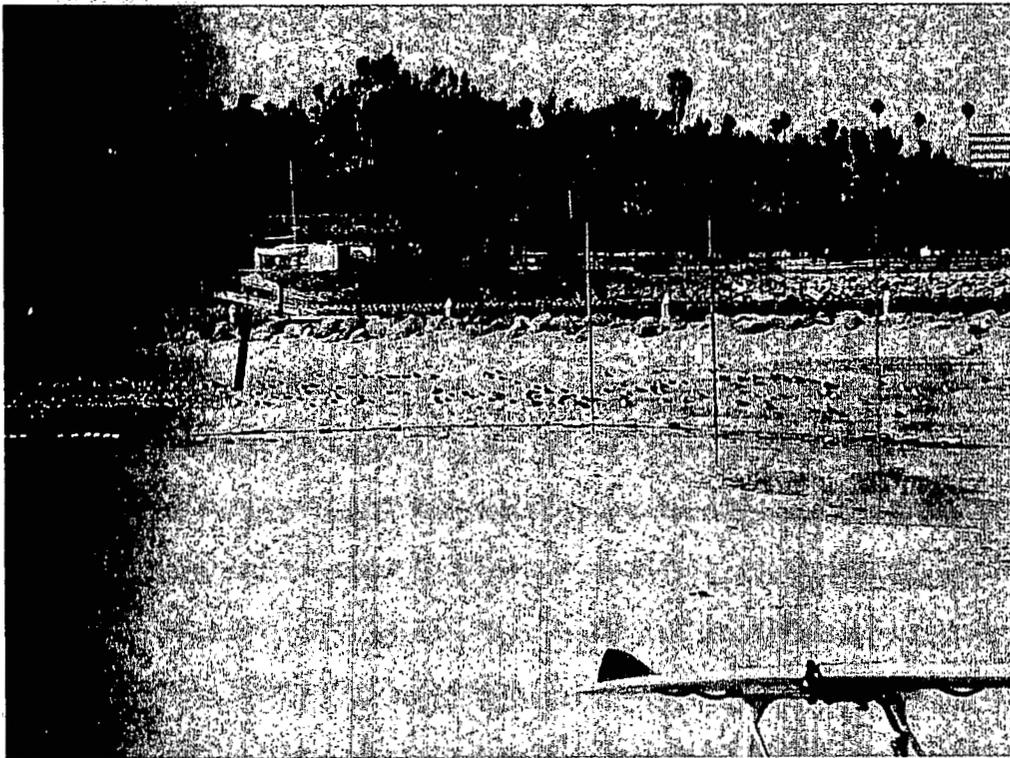


Figure 7-7. Effectiveness of Bird Exclusion Structure on Southern Portion of Cabrillo Beach

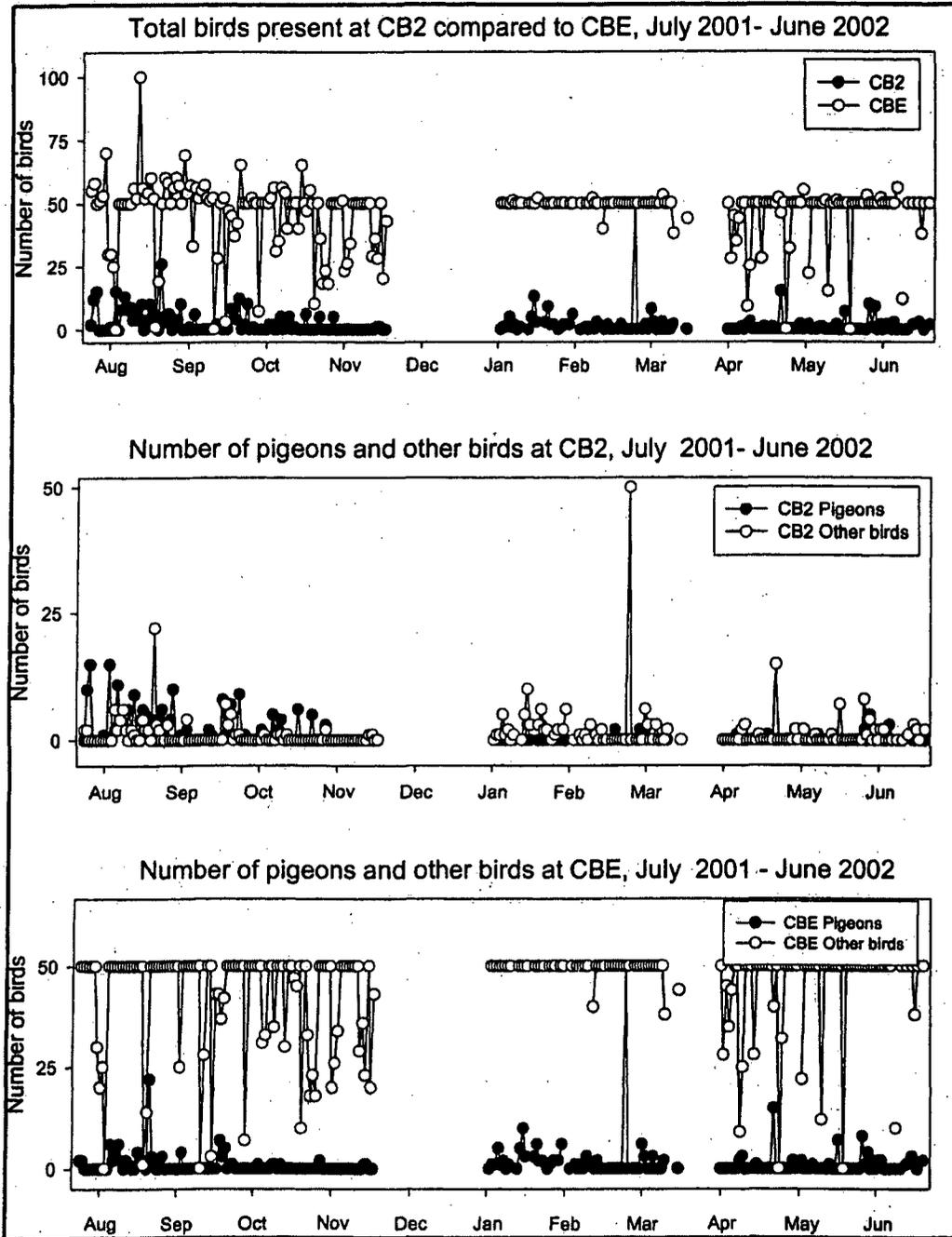


Figure 7-8. Bird Counts by Species and Location at CBE and CB2 (Dalkey and Baharance, 2003)

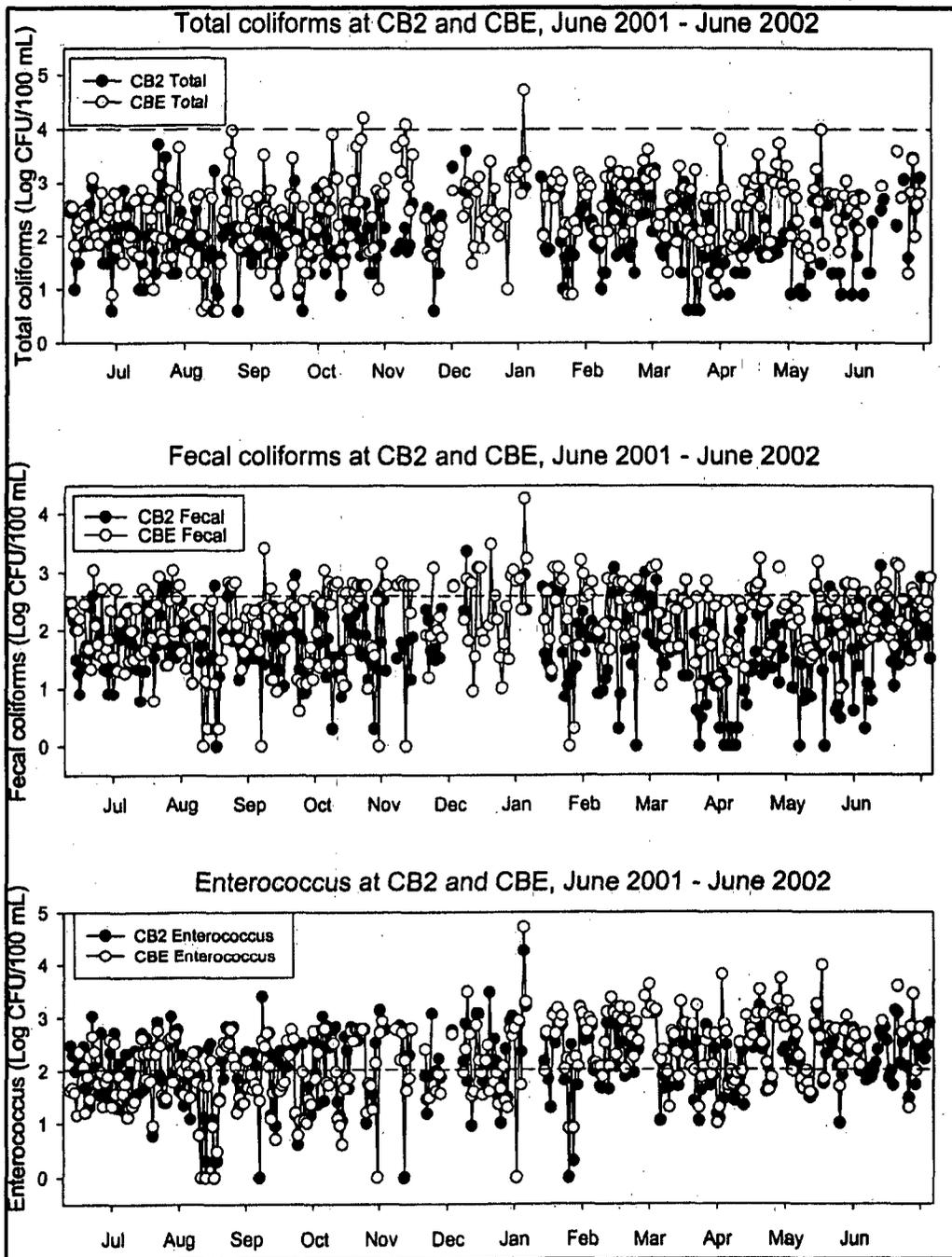


Figure 7-9. Comparisons of Bacterial Concentrations at CBE and CB2 (Dalkey and Baharance, 2003) (dashed lines indicate water quality standards)

frequently exceeded water quality standards at both sampling locations. Bacterial data from rainy days were excluded from this study (Dalkey and Baharance, 2003). Gulls and pigeons were counted only up to a total of 50 individuals. Pigeons were counted because concern existed that they might move into the beach area following the displacement of the gulls and other marine birds (Figure 7-10). (No effort to identify the marine birds was made in this study).

A statistically significant result suggested that the bird exclusion structure was effective at reducing bacterial contamination in the swimming area (Figure 7-9, Dalkey and Baharance, 2003). Pigeons were the predominant bird present under the exclusion structure. Bird counts outside the exclusion structure were typically high, though the number of pigeons was about the same as under the structure. Despite the presence of birds beneath the exclusion area, the number of birds did not correlate to the bacterial counts measured in the exclusion area (Figure 7-11, Dalkey and Baharance, 2003).

Bacterial results varied by an order of three times or more. After applying a Mann-Whitney Rank Sum test, it was determined that fecal coliform, total coliform, and enterococci at station CB2 were significantly less than concentrations determined in sampling efforts prior to the installation of the exclusion structure (Figure 7-12, Dalkey and Baharance, 2003).

7.5 Conclusions

Exceedance of California State Water Quality Standards occurred less frequently following the installation of the bird exclusion structure (Table 7-2). The standards most frequently exceeded were those for *enterococcus*, fecal coliform, and the fecal to total coliform ratio. The higher frequency of fecal coliform and *enterococcus* exceedances indicate that the bacterial contamination more likely fecal pollution rather than runoff pollution. The bacterial contamination of the water at Cabrillo Beach was not fully mitigated by the presence of the bird exclusion structure. Improving water circulation within the area would likely improve the water quality at Cabrillo Beach (Dalkey and Baharance, 2003).

Table 7-2. Frequency of California State Bathing Water Standards exceedances during a six month period prior to and following installation of Bird Exclusion Structure at Cabrillo Beach (Dalkey and Baharance, 2003)

Parameter	AB411	1999	2001	
	Standard*	CB2	CB2	CBE
Total Coliform	10000	2.8%	0.6%	2.5%
Fecal Coliform	400	32.2%	10.4%	27.6%
<i>Enterococcus</i>	104	51.7%	23.7%	43.1%
Fecal:Total w/total>100	0.1	18.8%	3.9%	37.0%

*Colony forming units (CFU) per 100 mL.

Following installation of the bird excluder, Heal the Bay grades of water quality at the beach improved, from predominantly failures to approximately a "C" average on a monthly basis, Figure 7-13 (Heal the Bay, 2003). Total violations at CB2 dropped significantly following the installation of the structure, although some months continued to display a violation rate as high as 30 to 36 percent. Bird usage of the beach varies widely from day to day and month-to-month, though it is clear that the bird exclusion structure has successfully limited bird usage on the southern side of the beach.

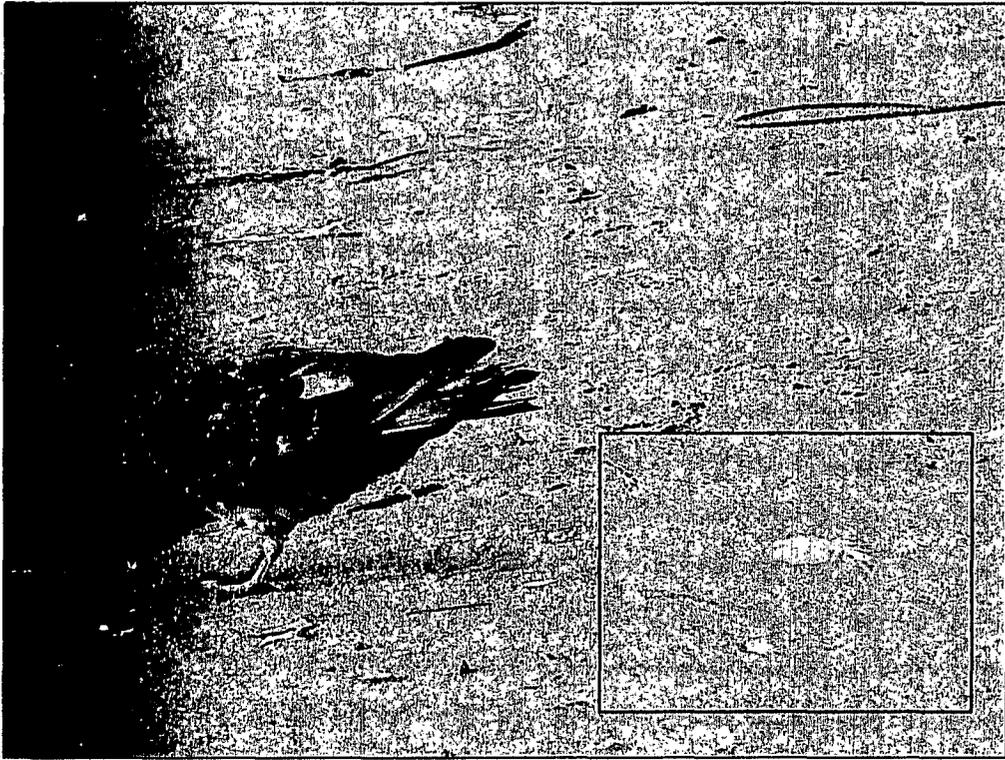


Figure 7-10. Bacterial Contamination from Pigeons

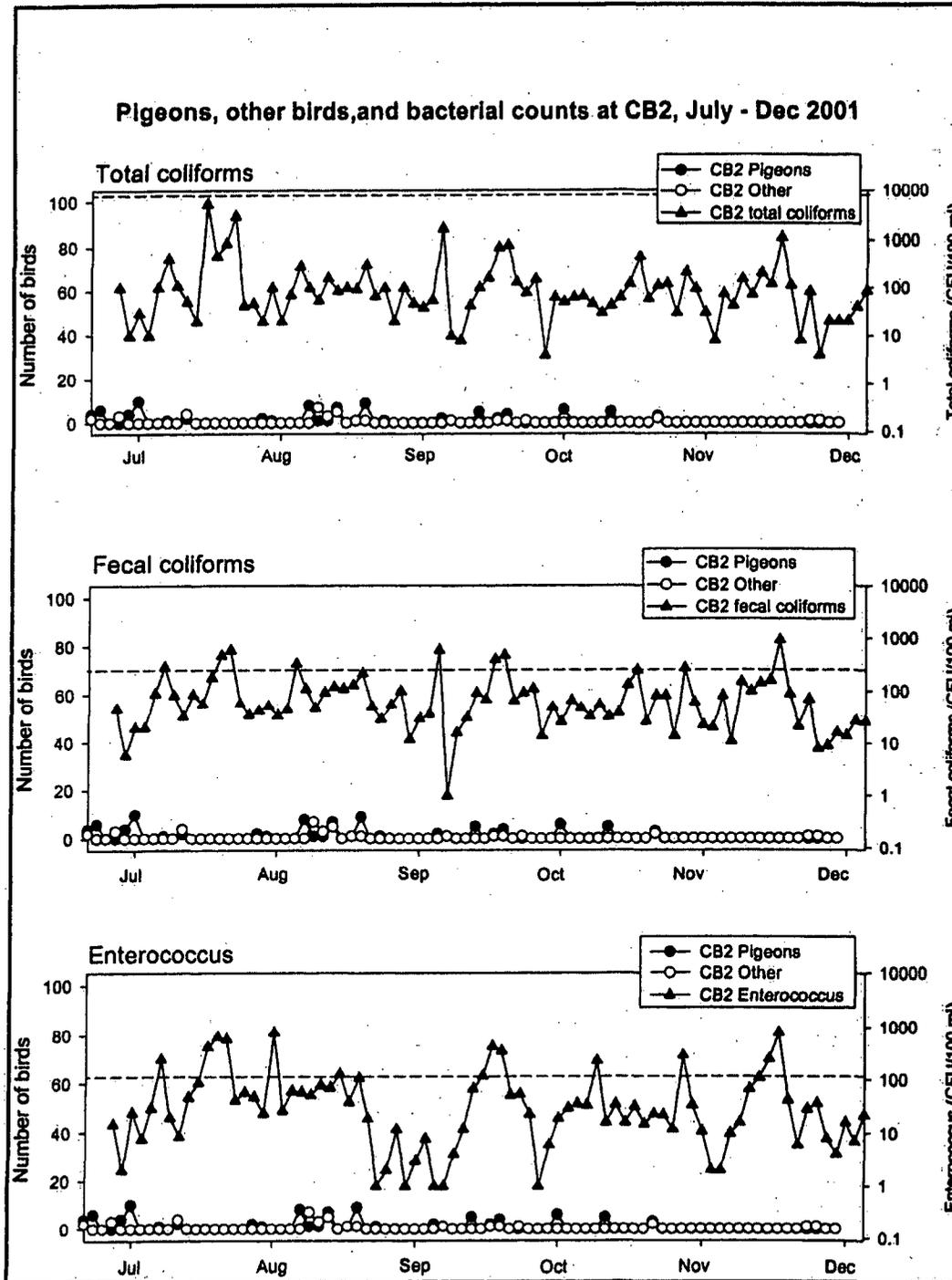


Figure 7-11. Bird Counts and Bacterial Concentrations at CB2 (Dalkey and Baharance, 2003) (dashed lines indicate water quality standards)

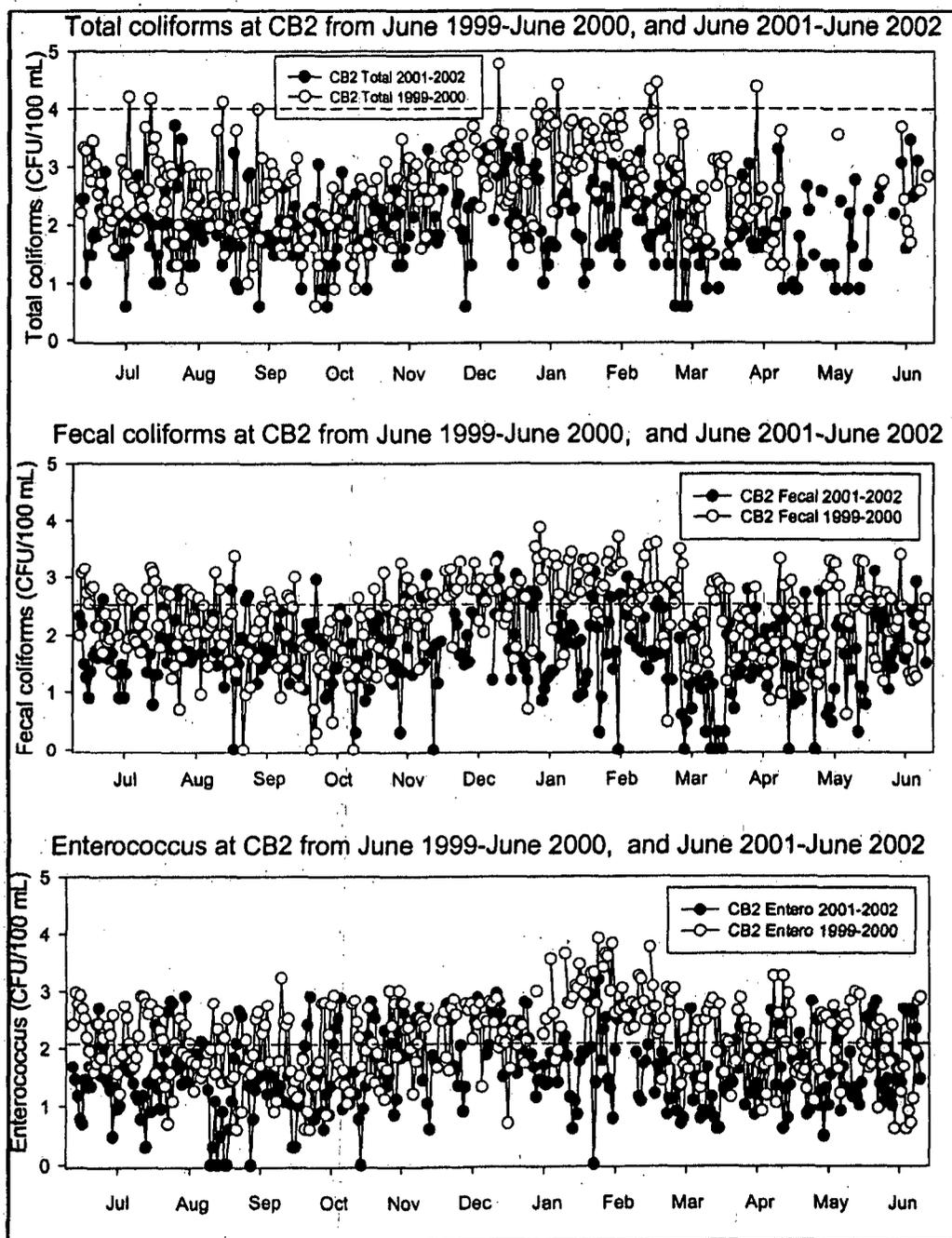


Figure 7-12. Total and Fecal Coliform, and *Enterococcus* Concentrations at CB2 (Dalkey and Bahariance, 2003) (dashed lines indicate water quality standards)

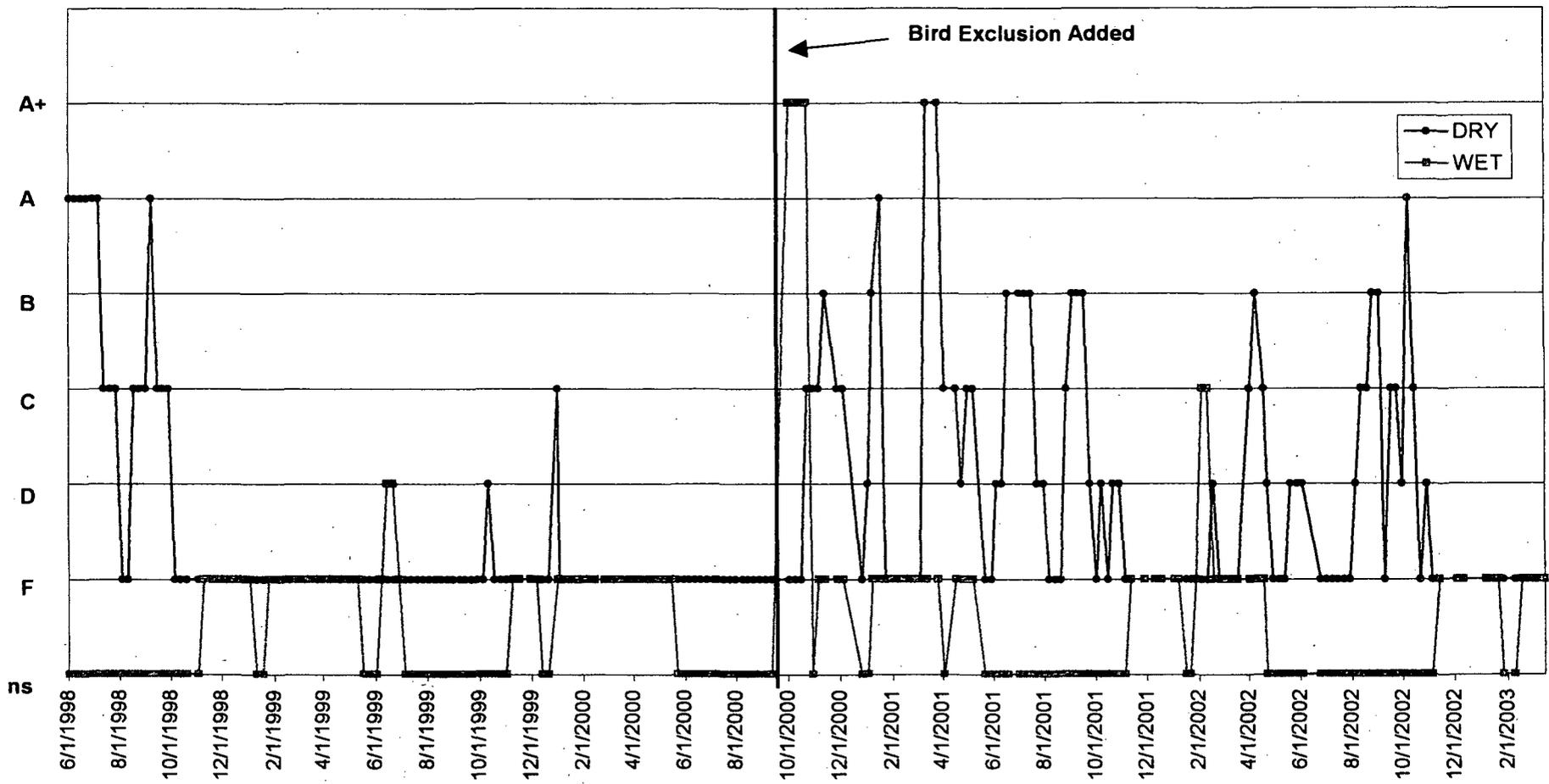


Figure 7-13. Heal the Bay Beach Grades for Cabrillo Inner Beach Life Guard Stand

8.0 DATA EVALUATION AND DATA GAPS

Inner Cabrillo Beach is a valuable recreational area for the Los Angeles urban area for residents as well as visitors to the area. However, violations of bacterial water quality standards at Inner Cabrillo Beach frequently result in beach closure. Monitoring records indicate that bacterial contamination of this beach area has been severe for many years.

Considerable data has been accumulated with respect to Cabrillo Beach water quality from the City of Los Angeles Bureau of Sanitation's daily beach and Harbor monitoring efforts. A number of special studies have also been conducted to investigate the sources and possible solutions to the continuing bacterial problems at Cabrillo Beach. In addition to the monitoring of Cabrillo Beach and adjacent waters, the Port of Los Angeles and the Corps of Engineers are working on Port improvement projects that require modeling, field monitoring, and design changes in the Port's configuration.

8.1 Conclusions

From the presently available data and studies the following conclusions may be drawn:

8.1.1 Violations

- Inner Cabrillo Beach has a long history of frequent bacterial violations of water quality standards.
- A seasonal signal appears to be in the data, but dry weather violations are also common.
- Violations occur during both the winter (wet season) and the summer (dry season). Violations occur frequently during rainy days, but also very frequently during dry days.
- Most violations are caused by high levels of fecal coliform and enterococcus.

8.1.2 Comparison of Cabrillo Beach Shoreline Sites

- The percent of violations at Site CB02 on Inner Cabrillo Beach is well above the percent of violations at the other Cabrillo beach stations, with the exception of Site CBE (when data available) located on the northern end of Inner Cabrillo Beach.
- Site CB01 (located at the launch ramp and separated from Inner Cabrillo Beach by the rock groin), was noticeably lower in total violations but still showed a significant number of violations.
- The open ocean beach at Outer Cabrillo Beach showed few bacterial violations.

8.1.3 Comparison of Inner Cabrillo Beach and Offshore Water Sites

- The percent of violations at Inner Cabrillo Beach is far higher than the relatively few violations in the Harbor waters offshore of the Beach.
- Comparisons of data from the Inner Cabrillo Beach with offshore water sites indicate that the contamination observed at Inner Cabrillo Beach is from a local source, and is not introduced to the beach by Harbor waters.

8.1.4 Comparison of Other Beach Sites.

- Violations occur much more frequently at Inner Cabrillo Beach than at other similarly protected urban beaches within the Harbor.

- At other similarly protected urban beaches within the Harbor, bacterial water quality violations are almost always directly related to rain events.
- These results indicate a local source of bacterial contamination at Cabrillo Beach.

8.1.5 Sanitary Collection System and Storm Drainage System

- Sanitary surveys at Cabrillo Beach have historically involved sampling interstitial water in the beach sands along transects from the rest rooms to the water. Indicator bacteria in this interstitial water were below advisory levels, suggesting that the bathroom facilities were an unlikely source of contamination.
- A thorough sanitary survey has not been conducted at Cabrillo Beach, but sources involving sewage and storm water conveyances are not readily apparent at Cabrillo Beach.
- Tide line water samples showed the highest values for total coliform, E. coli, and enterococcus in samples collected at ankle depth. All knee and chest level counts (further out into the water) were below water quality standards.
- Sand samples collected near the tide line indicated that the beach sands are contaminated with bacteria. Water samples taken at the tide line were highest on the northern end of Inner Cabrillo Beach, and water offshore was below advisory levels. Sand containing bird fecal matter when extracted with sterile seawater showed exceeding high values for indicator bacteria organisms.

8.1.6 Avian Sources of Contamination

- Data implicate high local bird use at Inner Cabrillo Beach as the source of bacterial contamination measured at tide water on the sand beach, though daily bird counts do not appear to directly correlate with daily bacterial counts.
- Cabrillo Beach and its adjacent waters serve as roosting or foraging habitat for moderate numbers of birds, mainly gulls and their allies. Bird occupation of the Cabrillo Beach and adjacent areas (total 8 habitats) comprises mostly gulls, terns and skimmers (Larinae) which together account for over 75% of the total birds in the Cabrillo Beach vicinity.
- The large population of roosting gulls was identified as the most significant source of bacterial contamination at Cabrillo Beach. In order to reduce the population and use of the beach by gulls, a bird exclusion structure was constructed in September of 2000.
- From 19 October 2000 through 5 January 2001, 96% of total birds present on the beach were observed on the northern portion of the beach and only 4% of the birds were on the southern portion beneath the bird exclusion structure (CLA, 2001). Although it is bird usage of the southern portion of the beach has historically been much less than usage of the northern portion of the beach, and bird usage of the beach varies widely from day to day and month to month, it is clear that the bird exclusion structure has successfully limited bird usage on the southern side of the beach. Total bird usage of the entire beach did not appear to change substantially.
- Bacteria levels were, on average, 20% higher at the site outside of the bird exclusion structure, (CBE) than at the sample site under the structure (CB2).
- The frequency of exceedances of the California State Bathing Water standards decreased by 65% following the installation of the bird exclusion structure. Total violations at CB2 dropped significantly following the installation of the structure, although some months continued to display a violation rate as high as 30 to 36 percent.
- The bacterial contamination of the water at Cabrillo Beach was not fully mitigated by the presence of the bird exclusion structure.

8.1.7 Circulation

- The U. S. Army Corps of Engineers has carried out a series of modeling and design studies associated with Port improvement projects.
- There are only minor differences between water circulation and water quality results for the base scenario and the conditions after deepening of the outer Harbor, constructing Pier 400, and building the Shallow Water Habitat (Pier 400 Project). This indicates no significant impact on waters within 300 to 500 feet of the Inner Cabrillo Beach. Currents approximately 3000 feet from shore were strengthened as a result of construction, however water quality was not impacted within western San Pedro Bay.
- There are only minor differences predicted in water circulation and water quality for the proposed inner Harbor deepening and Shallow Water Habitat expansion, indicating that expanding the habitat will have no significant impact on water circulation and water quality in western San Pedro Bay.
- An opening in the breakwater could have some positive impact on water circulation and water quality in western San Pedro Bay. The improvement could be attributed to the mixing of open-ocean and bay waters. However, the opening would have little impact on water immediately adjacent to the beach (i.e. in the area used for swimming). An opening in the breakwater would raise other issues not studied, including breakwater stability, erosion of the Harbor bottom (including the Cabrillo Shallow Water Habitat), harbor resonance, beach stability/erosion, and wave climate effecting safety of toddlers and novice swimmers at the Inner Cabrillo Beach.
- A nearshore circulation study is now being conducted at Inner Cabrillo Beach by the U. S. Army Corps of Engineers (and Evans-Hamilton, Inc.) involving dye tracing and current studies.

8.1.8 Management Practices

Present management practices pertinent to the present bacterial contamination study include the following:

- Cabrillo Beach is closed during nighttime hours and is patrolled by Harbor Police.
- Beaches are raked daily with a tractor to remove debris, primarily in the form of floatable detritus emplaced by the tide. Detrital material includes eelgrass from the beds just off the beach, trash from the Harbor, as well as materials originating from human use at Cabrillo Beach.
- Dogs are restricted to the upland parks on leash only, and are prohibited from Cabrillo Beach itself.
- Signage to control human activities is posted that include prohibitions of tents or camping on the beaches, littering, open fires, alcoholic beverages and the like.
- Signs also warn against feeding birds and feral cats.

8.2 Recommendations

Present data strongly indicate a local source of contamination at Inner Cabrillo Beach. The following preliminary recommendations are made:

Further investigation of potential sources including:

- A more thorough survey and testing of the sanitary and storm sewer systems at Inner Cabrillo Beach to be sure that no possibilities have been overlooked.
- Further investigations of avian sources of bacterial contamination.

Identification of potential solutions should include:

- Further exclusion of birds from the Inner Beach, by extension of the exclusion structure or by other means.
- Conceptual development of improved circulation solutions if needed and feasible.

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